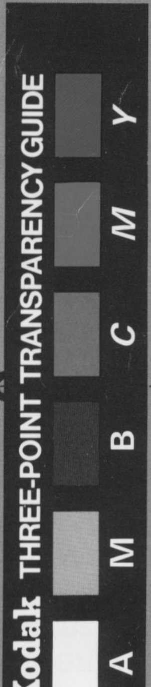
Q-7A | $1.5

SILVER MASKING OF TRANSPARENCIES
with three-aim-point control



Photomechanical color reproduction is based on the use of separation negatives exposed through appropriate color filters. These separation negatives, however, require "color correction" in order to give satisfactory color reproduction. Such correction can be accomplished through the use of photographic masks to modify the separation-negative image.

This pamphlet provides instructions for the use of silver masks and three-aim-point control in the masking of transparent copy for photomechanical reproduction. Other masking methods—for both transparent and reflection copy—are discussed in Kodak Data Book No. Q-7, **Basic Color for the Graphic Arts,** sold by graphic arts dealers. Data Book No. Q-7 also describes the theory of color as it applies to the graphic arts, the principles of color separation, and the equipment needed for masking and color separation.

MATERIALS AND EQUIPMENT FOR SILVER MASKING OF TRANSPARENCIES

Films

KODAK Pan Masking Film 4570
KODAK Separation Negative Film 4131, Type 1

Chemicals

KODAK VERSATONE 868 Developer, KODAK Developer DK-50,
  or KODAK HC-110 Developer
KODAK Indicator Stop Bath
KODAK Rapid Fixer

Equipment

Modified KODAK Adjustable Safelight Lamp, Model B, or equivalent
KODAK Register Printing Frame
KODAK Register Punch, or KODAK Precision Register Punch
KODAK WRATTEN Filters: No. 25, 33, 47B, 58, 81EF, 85B, 90,
  and Neutral Density, No. 96, in densities of 0.30, 0.60, and 1.00
KODAK Color Compensating Filter CC50G
KODAK Diffusion Sheets
KODAK VERSAMAT Film Processor, Model 317

Controls

KODAK Process Thermometer, Type 3
KODAK Timer
KODAK Reflection-Transmission Color Densitometer, Model 10-K,
  or equivalent
KODAK Three-Point Transparency Guide
KODAK Graphic Arts Color-Separation Calculator
KODAK Continuous-Tone Process Control Strips

Silver Masking of Transparencies With Three-Aim-Point Control

Page

THE METHOD IN OUTLINE 2

WHY THREE-AIM-POINT CONTROL? 3

THE MASKS 4
PREPARING THE TRANSPARENCY 4
EXPOSING THE MASKS 5
PROCESSING THE MASKS 6
KODAK VERSAMAT Film Processor, Model 317 6
Tray Processing 7
CHECKING THE MASKS 8

THE SEPARATION NEGATIVES 12
PREPARATION 12
EXPOSING THE NEGATIVES 12
PROCESSING THE NEGATIVES 13
KODAK VERSAMAT Film Processor, Model 317 13
Tray Processing 14
CHECKING THE NEGATIVES 15

THE HALFTONE POSITIVES 16
MAKING THE HALFTONES 16
HALFTONE SCREEN ANGLES 17

DENSITY MEASUREMENT OF HALFTONES 19
THE DENSITOMETER 20
MAKING AND INTERPRETING READINGS 21
ADAPTING THE DENSITOMETER TO READ IN PERCENT DOT AREA 23

CONTACT-PRINTING LAMP 24
CONTROL OF LINE VOLTAGE VARIATIONS 24
ADJUSTING EXPOSURE TIME TO LAMP DISTANCE 25

CORRECTING TRANSPARENCIES FOR REPRODUCTION 26
ADJUSTING COLOR BALANCE IN TRANSPARENCIES 26
EQUALIZING—COMPENSATING FOR DARK OR LIGHT TRANSPARENCIES 27
NORMALIZING GANGED TRANSPARENCIES 28
IMAGE ORIENTATION 30

VIEWING CONDITIONS FOR ORIGINALS AND REPRODUCTIONS 31
VIEWING CONDITIONS FOR THE APPRAISAL OF COLOR QUALITY 32
VIEWING CONDITIONS FOR THE APPRAISAL OF COLOR UNIFORMITY 32

ADDITIONAL NOTES 33
TRANSPARENCY MASKING ON THE PROCESS CAMERA OR ENLARGER 33
MASK NUMBER 34
HIGHLIGHT MASK 36
UNDERCOLOR REMOVAL MASKING 36

Standard Book Number
0-87985-090-6

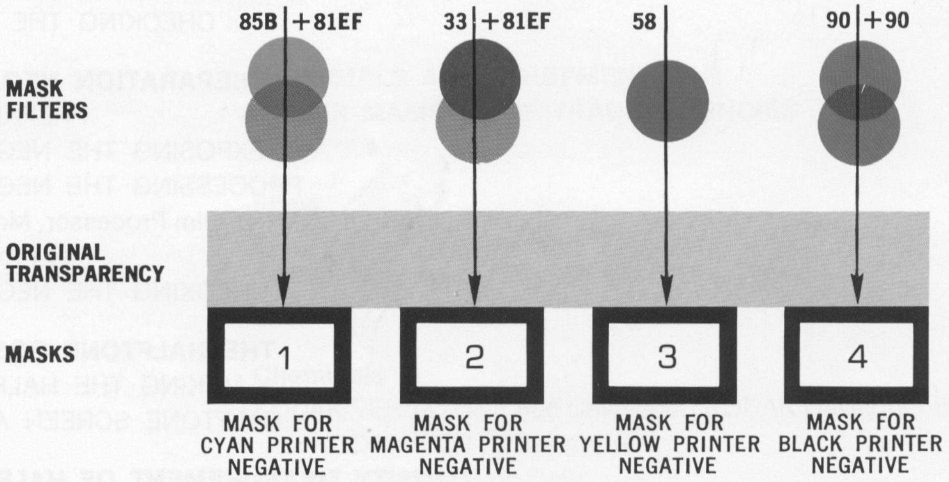
© Eastman Kodak Company, 1974

The Kodak materials described in this publication are available from those dealers normally supplying Kodak materials for the graphic arts.

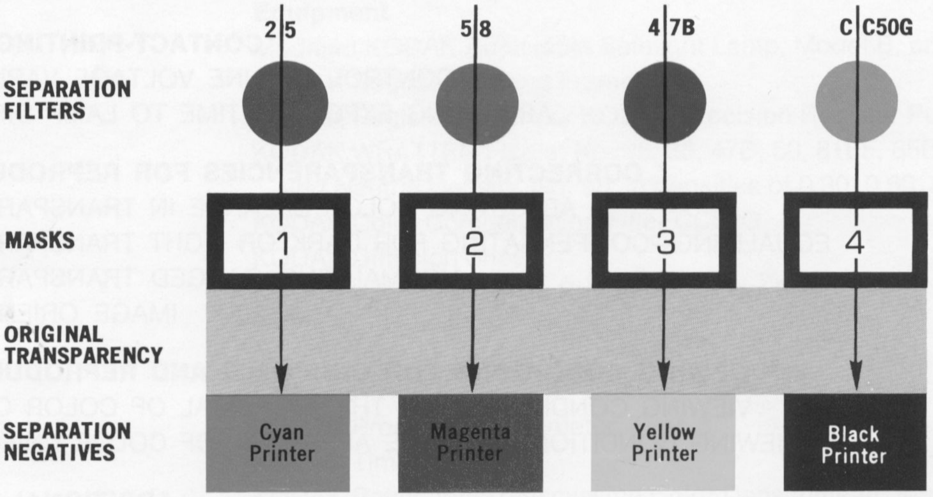
The Method in Outline

The masks and separation negatives are made by contact printing from the transparency. Four masks are made: one each to mask the cyan, the magenta, the yellow, and the black separation. Each mask, in turn, is registered with the transparency, and four separation negatives are made from the masked transparency. The flowcharts below show the steps.

MAKING THE MASKS


85B +81EF
33 +81EF
58
90 +90
MASK FILTERS
ORIGINAL TRANSPARENCY
MASKS
1
2
3
4
MASK FOR CYAN PRINTER NEGATIVE
MASK FOR MAGENTA PRINTER NEGATIVE
MASK FOR YELLOW PRINTER NEGATIVE
MASK FOR BLACK PRINTER NEGATIVE

MAKING THE MASKED SEPARATIONS

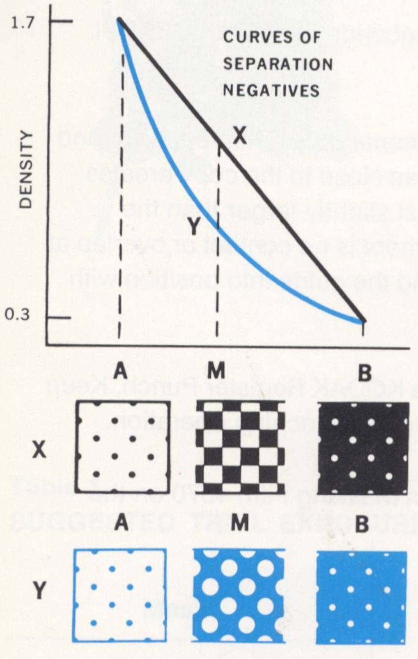


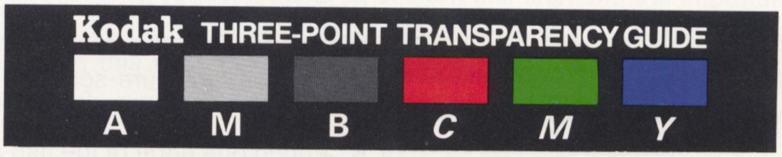
Why Three-Aim-Point Control?

Control of tone reproduction in transparency masking was formerly based on the use of two aim points. These were a highlight density and a shadow density, with a density range of 2.0 between them. The use of a third aim point improves control of the reproduction.

With only two aim points (for example, **A** and **B** in the illustration at the left) to control the separations, the overall curve shape was not completely defined. Both the separations marked **X** and **Y** would have identical end points (0.3 density in the **B** step and 1.7 in the **A** step) but would give different results in the final reproduction. Separation **Y** would result in greater highlight contrast, darker middletones, and flatter shadows than would separation **X**. This is shown in the halftone scales **X** and **Y** when the two separations are screened to obtain comparable highlight and shadow dots. It is clear that between these two end points there could be many curves of different shape. The Three-Aim-Point Method adds a midpoint control step, **M**, to the conventional **A** and **B** end-points. The use of the third aim point more accurately defines the curve shape of the separation negative and helps to provide the proper tone scale and color balance for good reproduction.

The KODAK Three-Point Transparency Guide* provides the three control densities: A, M, and B. In addition, the patches labeled "C," "M," and "Y" provide easy identification of the separation negatives.





---

*Kodak Publication No. Q-6C, **KODAK Three-Point Transparency Guide,** sold by graphic arts dealers.

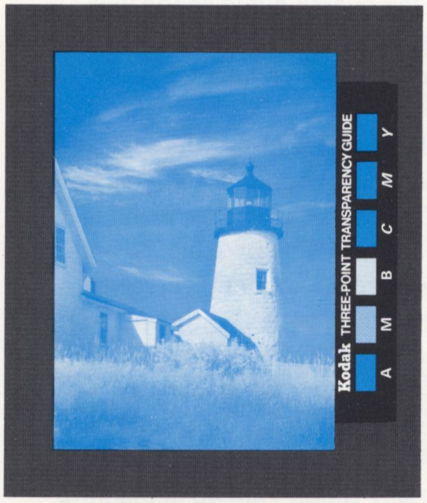
The Masks

PREPARING THE TRANSPARENCY

Check the transparency for proper balance on a 5000 Kelvin color illuminator. If the color balance is not satisfactory, see "Adjusting Color Balance in Transparencies," page 26.

Insert the transparency and a KODAK Three-Point Transparency Guide into windows that are cut into a sheet of film with a neutral background density of 0.7 to 1.0. The purpose of this holder, or "jig," is to provide a neutral density surround for the transparency and the control patches. The density of the jig is equivalent to the average density of the transparency. Its use helps to reduce developer adjacency effects* which might cause false densities in the control patches.

The neutral density jig can be prepared as follows:



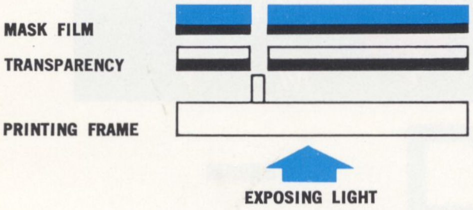
Neutral density "jig" with transparency and control patches in place.

1. Choose a sheet of KODALITH Ortho Film 4556, Type 3 (ESTAR Thick Base), one film-size larger than the transparency you are going to mask. This size film will provide enough gray area around the transparency and leave room for both the Transparency Guide and the pin register.

2. Flash-expose the film for about 4 seconds with a modified KODAK Adjustable Safelight Lamp† at 40 inches. Use a KODAK WRATTEN Neutral Density Filter, No. 96, with a 1.0 density, in the safelight lamp, with the lamp operating on an 8-volt tap.

3. Develop the exposed film for 90 seconds in KODAK DEKTOL Developer (1:1) at 20 C (68 F).

4. Cut a centered window for the transparency. Then cut a second window for the Transparency Guide as close to the copy area as practical. The windows should be just slightly larger than the transparency and the guide, so that there is no contact or overlap at the edges. Tape the transparency and the guide into position with transparent pressure-sensitive tape.



Assembly for mask making. The heavy black lines represent emulsion sides of the transparency and mask film.

5. Punch one edge of the film on the KODAK Register Punch. Keep the transparency **emulsion up** during the punching operation.

6. Punch four sheets of KODAK Pan Masking Film 4570 on the register punch, **emulsion side up.**

---

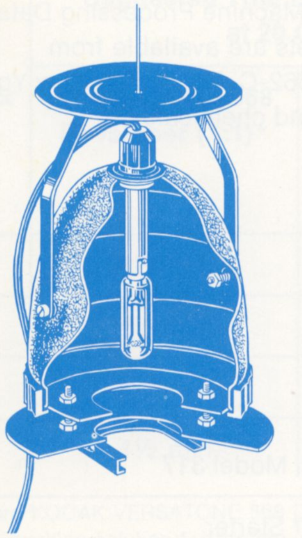
*__Adjacent effect__—When small areas, such as the control patches of the Transparency Guide, are surrounded by large, fully developed black areas, the small patches may receive less-than-normal development due to local exhaustion of the developer.

†This and other lamps suitable for use in transparency masking are described in Kodak Pamphlet No. Q-80, **Contact-Printing Lamp for Photomechanical Work,** available on request.

7. Place the transparency assembly on the pins of the KODAK Register Printing Frame, emulsion side down. Then place a sheet of punched masking film on the pins, also emulsion side down. (If you use a vacuum easel in place of the printing frame, simply reverse the order of the mask assembly. Further details on image orientation are given on page 30.)

8. Close the printing frame, turn it over, and center it below the exposing lamp.

NOTE: A certain degree of unsharpness is wanted in the mask. This makes register with the transparency easier and increases sharpness of detail in the reproduction. KODAK Pan Masking Film has built-in diffusion to provide mask unsharpness.



EXPOSING THE MASKS

Expose each mask separately, using the filters and exposure times recommended in Table 1 below. The suggested exposures are based on an illumination level of 8 footcandles at the exposure plane. This is an average measurement with a bare lamp in a modified KODAK Safelight Lamp, or equivalent, operating on the 16-volt tap with 40 inches between lamp and printing frame. (If a larger area of illumination is needed, the lamp-to-frame distance may be increased. Use the nomograph, page 25, to convert to equivalent exposure times.)

NOTE: For the best possible uniformity of illumination, a piece of KODAK Diffusion Sheet may be used in the lamp filter frames along with the WRATTEN Filters. The diffusion sheet eliminates the effect of striations in the glass of the lamp bulb. However, since the diffusion sheet slightly reduces the area of even illumination, it is important to center the printing frame under the lamp. When a diffusion sheet is used in this way, the exposure times given in the table should be doubled.

Table 1
SUGGESTED TRIAL EXPOSURE TIME, IN SECONDS

Mask	Suggested KODAK WRATTEN Filter No.	Suggested Trial Exposure Time	Lamp Setting
1 (for Cyan Printer)	85B + 81EF + 1.0 ND	12 seconds	40 inches above frame. 16-volt tap
2 (for Magenta Printer)	33 + 81EF + 0.3 ND	12 seconds	
3 (for Yellow Printer)	58 + 0.3 ND	12 seconds	
4 (for Black Printer)	90 + 90 (2 filters)	30 seconds	

NOTE: A split-filter exposure may be used for the No. 2 mask with the combination of KODAK WRATTEN Filters No. 25 and No. 47B in place of the single exposure with a KODAK WRATTEN Filter No. 33. A ratio of 8 or 10 parts red to 1 part blue exposure is a good starting point to determine a ratio for your specific conditions. Use of the split-filter exposure should give cleaner greens and improve red saturation in the reproduction.

PROCESSING THE MASKS

KODAK VERSAMAT Film Processor—The masks exposed on KODAK Pan Masking Film 4570 can be processed either in a tray or in a mechanized processor such as the KODAK VERSAMAT Film Processor, Model 317. Basic machine-processing conditions are given in Table 2. Further information on machine processing of KODAK Pan Masking Film—particularly in regard to establishing average replenishment rates and for fine-tuning the average machine speeds in the table—is contained in the Machine Processing Data Release for this film. Data Release Sheets are available from Eastman Kodak Company, Department 662-C, Rochester, New York 14650. Please specify film, processor, and chemicals.

Table 2
SUGGESTED MACHINE-PROCESSING CONDITIONS
KODAK Pan Masking Film 4570

Processor	KODAK VERSAMAT Film Processor, Model 317
Processing Solutions	KODAK VERSATONE 868 Developer Starter KODAK VERSATONE 868 Developer Replenisher KODAK Rapid Fixer
Processing Temperatures	Developer .... 80 F ± ½ F Wash .... 70 to 75 F Dry .... 100 F
Machine Speed	
Mask 1 (for Cyan Printer)	15 in. per min
Mask 2 (for Magenta Printer)	15 in. per min
Mask 3 (for Yellow Printer)	15 in. per min
Mask 4 (for Black Printer)	15 in. per min
Process Control	Kodak Continuous-Tone Process Control Strips. (Instructions are packaged with the strips.)
Basic Replenishment Rates	Developer—0.25 ml per square in. Fixer—0.50 ml per square in.

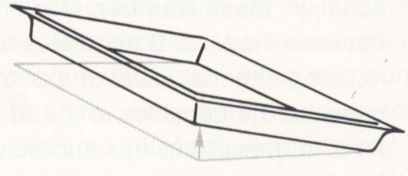
Tray Processing—Develop the masks in KODAK VERSATONE 868 Developer, in KODAK Developer DK-50, or in KODAK HC-110 Developer for the times and dilutions shown in Table 3. The masks may be developed singly or two at a time, back to back, by turning the pair over in the tray at the end of each agitation cycle. A constant agitation cycle may be maintained by lifting each side of the tray, in turn, to flow the developer smoothly across the films. For 8 x 10-inch films, the complete cycle of four tray rocks should take about 5 seconds. (Increase this time interval for larger film sizes.) This technique helps to standardize agitation for more consistent development.

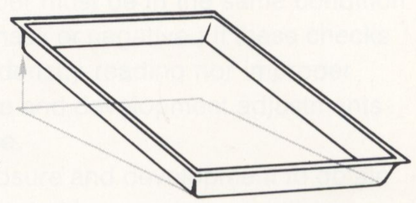
Table 3
TRAY PROCESSING TIMES
KODAK Pan Masking Film 4570

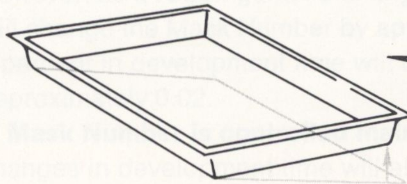
	Suggested Trial Development Times at 20 C (68 F)				Fix Continuous Agitation 18-21 C (65-70 F)		
Mask	**VERSATONE 868 Developer (1:1)***	**Developer DK-50 (1:1)**	**HC-110 Developer (Dilution D)**	**Stop Bath 12-21 C (65-70 F)**	**KODAK Rapid Fixer**	**KODAK Fixer**	**Wash at 18-21 C (65-70 F) in Running Water**
1	4½ min	3¼ min	3¼ min	10 sec	2-4 min	5-10 min	5 min
2	4½ min	3¼ min	3¼ min				
3	4½ min	3¼ min	3¼ min				
4	4½ min	3¼ min	3¼ min				

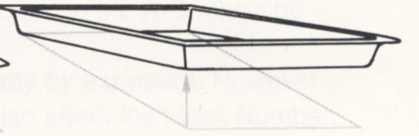
*Prepare KODAK VERSATONE 868 Developer Working Solution as directed in the instruction sheet packaged with the developer. Dilute working solution 1:1 for tray use.

NOTE: Development times are for average conditions. Some adjustment may be necessary for individual shop conditions.


1


2


3


4

While washing the masks, maintain a flow rate sufficient to replace the volume of water in the tray once a minute. A KODAK Automatic Tray Siphon provides efficient water feed at the bottom of the tray. After washing, squeegee off excess water and dry the masks, preferably at room temperature. (If the film is not squeegeed, a 15-second rinse in KODAK PHOTO-FLO Solution after washing will help draining and reduce water spots.)

When a drying cabinet is used, the temperature should be set according to the relative humidity of the air in the room. At every humidity there is a drying temperature which minimizes any size change due to processing.

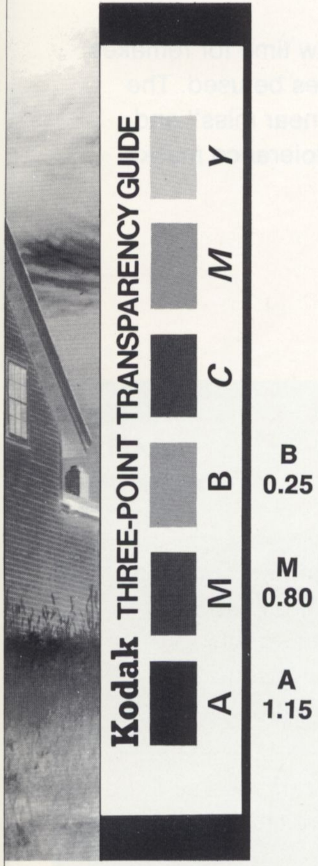
Relative Humidity of Surrounding Air	Suggested Range of Dryer Temperature for Minimum Processing Size-Change
30%	70— 75 F
40%	75— 85 F
50%	85—100 F
60%	100—110 F

If the masks are consistently oversize, it is an indication that they have been overdried and that the drier temperature should be reduced. Further information on the effect of drying temperature on film size is given in Kodak Pamphlet No. Q-34, **Dimensional Stability of KODAK ESTAR Base Films for the Graphic Arts,** available on request.

CHECKING THE MASKS

Two important characteristics of a mask are density range and curve shape. Density range is the numerically expressed difference in the densities of two specific points on the curve, such as the difference between the densities of the A and the M patches; or between the M and B patches. Curve shape is described by a reliable concept: **Mask Number.** Mask Number is the numerical difference between the M-to-B and the A-to-M density ranges of the mask.

Using either a visual or a photoelectric densitometer, carefully measure the densities of the A, M, and B patches on the mask. Record these densities and calculate the ranges and the Mask Number.



A-B DENSITY RANGE

Subtract the density value of the B patch from that of the A patch.

$A=1.15$
$\underline{B=0.25}$
$A-B=0.90$

M-B DENSITY RANGE

Subtract the density value of the B patch from that of the M patch.

$M=0.80$
$\underline{B=0.25}$
$M-B=0.55$

A-M DENSITY RANGE

Subtract the density value of the M patch from that of the A patch.

$A=1.15$
$\underline{M=0.80}$
$A-M=0.35$

MASK NUMBER

Subtract the A-M range from the M-B range.

$M-B=0.55$
$\underline{A-M=0.35}$
Mask Number$=0.20$

A satisfactory mask by the Three-Aim-Point Method should have a Mask Number of 0.20 and an A-B range of 0.90. It is difficult to meet such aim points with absolute accuracy in any reproduction process. Therefore, some amount is commonly specified by which the aim points may vary from the given value. This is the tolerance range.

Mask Number	**0.20 ± 0.05**
A-B Range	**0.90 ± 0.05**

These tolerances mean that any Mask Number from 0.15 to 0.25, and any A-B range from 0.85 to 0.95 may be acceptable. In dealing with a set of four masks, however, one mask should not be 0.05 **below** the aim point if another is 0.05 **above** the aim point. Keep all four masks within 0.05 of each other in both Mask Number and A-B range.

If the mask does not fall within these tolerance ranges, it should be remade. **Before remaking the mask,** however, it is wise to double-check the density readings. Also, it may save considerable time to check the repeatability of the technique by making a second mask by **exactly** the same procedure as used for the first mask. (For repeats or remakes of any kind, the developer must be in the same condition of freshness as it was for the faulty mask or negative.) If these checks indicate that neither an inaccurate density-reading nor improper procedure is at fault, make exposure and development adjustments to bring the aim points into tolerance.

The amount of adjustment in exposure and development to obtain a given correction in the mask is affected by your own conditions. However, as a **rough** guide, a change of 5 percent in exposure time will change the Mask Number by **approximately** 0.01. A change of 3 percent in development time will change the A-B range by approximately 0.02.

Mask Number is controlled mainly by exposure. However, changes in development time will also affect the Mask Number. Similarly, **the A-B range is controlled mainly by development time.**

However, exposure changes will also have a slight effect on the A-B range. Simultaneous changes in exposure and development, therefore, often help to avoid excessive remakes. The table on this page gives the direction of changes in exposure or development time, or both, to correct an unsatisfactory mask.

Since production schedules do not always allow time for remakes, masks outside the tolerance limits must sometimes be used. The individual operator must decide if he can use a "near miss" and compensate for it later. Bear in mind that out-of-tolerance masks usually create problems in later steps.

MASK CORRECTIONS

IF MASK NUMBER IS	AND A-B RANGE IS	
LOW	LOW	**Increase development time to increase the A-B range.** **If the Mask Number is only slightly low,** no exposure change is needed. The increased development will raise the Mask Number slightly. **If the Mask Number is very low,** increase exposure time slightly.
	CORRECT	**Increase exposure time to raise the Mask Number.** If you use a very large exposure increase, decrease development time slightly to hold the A-B range constant.
	HIGH	**Increase exposure time to raise the Mask Number.** **Decrease development time to decrease the A-B range.**
CORRECT	LOW	**Increase development time to increase the A-B range.** This development increase will also tend to raise the Mask Number. Decrease exposure time slightly to hold the Mask Number constant.
	CORRECT	**No change necessary.**
	HIGH	**Decrease development time to decrease the A-B range.** Since decreased development will tend to lower the Mask Number, you may need to increase exposure time slightly to hold the Mask Number constant.

The Separation Negatives

PREPARATION

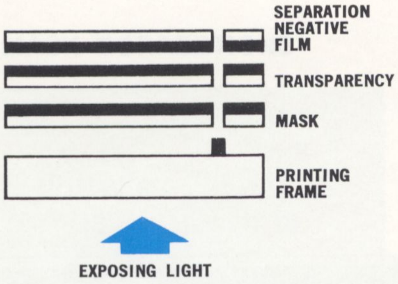
Register the mask for the cyan printer (Mask 1) with the transparency and measure the densities of the **masked** highlight of the transparency and the **masked** A patch. If the density of the masked A patch is 0.05 to 0.10 **higher** than the density of the masked highlight,* proceed with the steps below. If not, see "Equalizing—Compensating for Dark or Light Transparencies," page 27.

1. On the KODAK Register Punch, punch four sheets of KODAK Separation Negative Film 4131, Type 1, emulsion side down. (Use care not to scratch the emulsion.)

2. Assemble the materials on the pins of the KODAK Register Printing Frame in the following order:

- a. The mask, emulsion side up.
- b. The transparency, emulsion side up.
- c. The separation negative film, emulsion side down.

3. After locking the printing frame, turn it over, and center it beneath the same exposing lamp that you used for making the masks.



Assembly for negative making. The heavy black lines represent emulsion sides of the transparency and films.

EXPOSING THE NEGATIVES

Expose each negative separately, substituting the correct mask for each exposure. Use the filters and exposure times recommended in Table 4.

Table 4
SUGGESTED TRIAL EXPOSURE TIMES, IN SECONDS

Printer	Mask	Suggested KODAK WRATTEN Filter No.	Suggested Trial Exposure Time	Lamp Setting
Cyan	1	25 + 1.60 ND	15 seconds	40 inches above frame 16-volt tap.
Magenta	2	58 + 1.00 ND	12 seconds	
Yellow	3	47B + .60 ND	15 seconds	
Black	4	CC50G + 1.60 ND	15 seconds	

---

*The A patch will be used as a control patch when screening the separation negatives. A slightly higher density in the A patch compared with the transparency highlight will provide for a usable halftone dot in the A patch.

HIGH

IF MASK NUMBER IS	AND A-B RANGE IS	
HIGH	LOW	**Decrease exposure time to lower the Mask Number.** **Increase development time to increase the A-B range.**
	CORRECT	**Decrease the exposure time to lower the Mask Number.** If you use a very large exposure decrease, you may need to increase development time slightly to hold the A-B range constant.
	HIGH	**Decrease development time to decrease the A-B range.** **If the Mask Number is onlf slightly high,** this development decrease will also tend to correct the Mask Number. **If the Mask Number is very high,** decrease exposure time slightly.

ROUGH GUIDE TO ADJUSTMENTS

A change of 5 percent in exposure time will change the Mask Number by approximately 0.01.

A change of 3 percent in development time will change the A-B range by approximately 0.02.

PROCESSING THE NEGATIVES

KODAK VERSAMAT Film Processor—The separation negatives exposed on KODAK Separation Negative Film 4131, Type 1 can be processed either in a tray or in a processor such as the KODAK VERSAMAT Film Processor, Model 317. Basic machine-processing conditions are given in Table 5. Further information on machine processing of KODAK Separation Negative Film, Type 1—particularly in regard to establishing average replenishment rates and for fine-tuning the average machine speeds in the table—is contained in the Machine Processing Data Release for this film. These Data Release Sheets are available from Eastman Kodak Company, Department 662-C, Rochester, New York 14650. Please specify film, processor, and chemicals.

Table 5
SUGGESTED MACHINE-PROCESSING CONDITIONS
KODAK Separation Negative Film 4131, Type 1

Processor	KODAK VERSAMAT Film Processor, Model 317
Processing Solutions	KODAK VERSATONE 868 Developer Starter KODAK VERSATONE 868 Developer Replenisher KODAK Rapid Fixer
Processing Temperatures	Developer .... 80 F ± ½ F Wash .... 70 to 75 F Dry .... 100 F
Machine Speed	
Cyan Printer	12½ in. per min
Magenta Printer	15 in. per min
Yellow Printer	10½ in. per min
Black Printer	9½ in. per min
Process Control	KODAK Continuous-Tone Process Control Strips. (Instructions are packaged with the strips.)
Basic Replenishment Rates	Developer—0.25 ml per square in. Fixer—0.50 ml per square in.

Tray Processing—Develop the negatives in KODAK VERSATONE 868 Developer, in KODAK Developer DK-50, or in KODAK HC-110 Developer for the times and dilutions suggested in Table 6. These recommendations are for tray development with continuous agitation. A constant agitation cycle may be maintained by lifting each side of the tray, in turn to flow the developer smoothly across the film. For an 8 x 10-inch tray, the complete cycle of four rocks should require about 5 seconds. A longer time should be allowed with larger size films.

The negatives may be developed two at a time, back-to-back, by turning the pair over in the tray at the end of each agitation cycle.

After washing, squeegee off the excess water and dry the negatives, preferably at room temperature. (If the film is not squeegeed, a 15-second rinse in KODAK PHOTO-FLO Solution after washing will improve draining and help reduce water spots.)

When a drying cabinet is used, the temperature should be set according to the relative humidity of the air in the room, as discussed in "Processing the Masks," page 8.

DK50 = HC(c)

Table 6
TRAY PROCESSING TIMES
KODAK Separation Negative Film 4131, Type 1

	Suggested Trial Development Times at 20 C (68 F)					
Printer	**VERSATONE 868 Developer (1:1)***	**Developer DK-50 (Full Strength)**	**HC-110 Developer (Dilution C)**			
Cyan	5 min	4 min	4 min	Stop Bath 10 sec at 18-21 C (65-70 F)	Fix with continuous agitation at 18-21 C (65-70 F) for 2 to 4 min in KODAK Rapid Fixer or for 5 to 10 min in KODAK Fixer	Wash for 10 to 20 min in running water at 18-21 C (65-70 F). Use a flow rate sufficient to replace the tray volume once a minute.†
Magenta	4 min	3½ min	3½ min			
Yellow	5¾ min	4 min	4 min			
Black	7 min	3¾ min	3¾ min			

*Prepare KODAK VERSATONE 868 Developer Working Solution as directed in the instruction sheet packaged with the developer. Dilute working solution 1:1 for tray use.

†For archival permanence, use KODAK Clearing Agent.

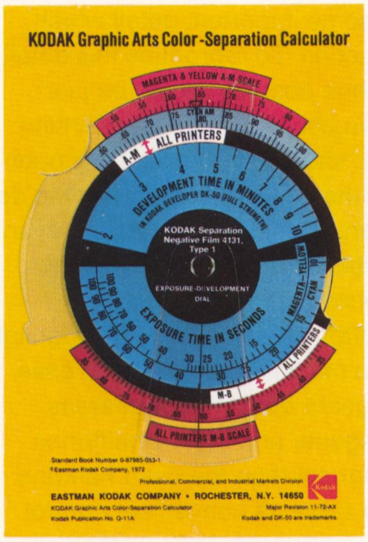
NOTE: These times are for average conditions. Some adjustment may be necessary for individual shop conditions.

CHECKING THE NEGATIVES

Measure the densities of the A, M, and B patches of the negative on the densitometer. Determine the A-M range and the M-B range as described under "Checking the Masks," page 8.

The cyan printer should be checked first. The average aim points for this negative are an A-M range of 0.80 and an M-B range of 0.60 for a total (A-B) range of 1.40. The aim points for the magenta and yellow negatives depend on the actual cyan printer you have obtained. To determine the proper aim points, use the **KODAK Graphic Arts Color-Separation Calculator,** Kodak Publication No. Q-11, sold by graphic arts dealers. The pamphlet supplied with the calculator gives the A-M/M-B subrange ratios equivalent to .80/.60 at 1.40 at any other A-B density range from 1.20 to 1.60. The pamphlet also describes in detail the tolerance ranges and the method of checking the negatives.

The same calculator is used to determine changes in exposure and development when a faulty negative must be remade. This procedure is also described in detail in the pamphlet included with the calculator. When using this calculator for transparency masking, make sure that you use the proper exposure-development dial. A dial for KODAK Separation Negative Film 4131, Type 1 in KODAK Developer DK-50 is included in the calculator packet. A supplementary dial for machine processing of KODAK Separation Negative Film, Type 1 in KODAK VERSATONE 868 Developer is available from graphic arts dealers as Kodak Publication No. Q-11F.


KODAK Graphic Arts Color-Separation Calculator
MAGENTA & YELLOW A-M SCALE
CYAN AM
A-M
ALL PRINTERS
DEVELOPMENT TIME IN MINUTES
IN KODAK DEVELOPER DK-50 (FULL STRENGTH)
KODAK Separation Negative Film 4131, Type 1
EXPOSURE-DEVELOPMENT DIAL
EXPOSURE TIME IN SECONDS
MAGENTA—YELLOW
CYAN
ALL PRINTERS
M-B
ALL PRINTERS M-B SCALE
Standard Book Number 0-87985-053-1
©Eastman Kodak Company, 1972
Professional, Commercial, and Industrial Markets Division
EASTMAN KODAK COMPANY • ROCHESTER, N.Y. 14650
KODAK Graphic Arts Color-Separation Calculator
Kodak Publication No. Q-11A
Major Revision 11-72-AX
Kodak and DK-50 are trademarks

NOTE: Separation negatives made as recommended here are designed for lithographic and letterpress printing. In gravure reproduction, the imbalance between the cyan and the other separations is not required. For gravure use, the general principles apply, but the aim points should be adjusted to fit your own requirements.

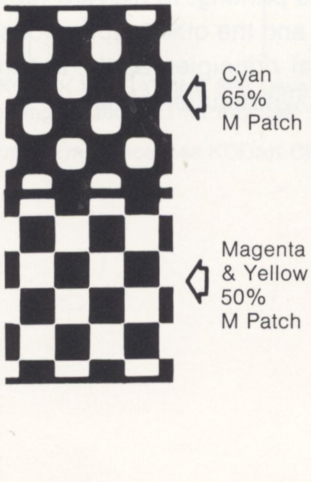
The Halftone Positives

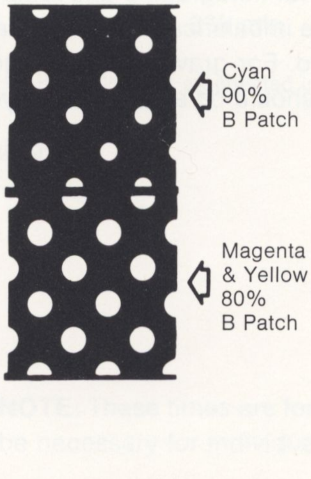
MAKING THE HALFTONES

Three-Aim-Point Control has been used in this masking method to obtain color-corrected separation negatives with the proper characteristics for good tone reproduction and color balance. One of these characteristics is an intentional imbalance in contrast and density range between the cyan printer and the other two color printers. This contrast imbalance is illustrated by the color-separation calculator's specification that the A-M range of the cyan should be 0.15 longer than the A-M ranges of the magenta and yellow. (For example, a cyan A-M range of 0.80 as compared with an A-M range of 0.65 for the magenta and yellow negatives.) This imbalance helps provide proper gray balance in the reproduction. It also allows all three negatives to be screened similarly.

Negatives prepared according to this Three-Aim-Point Method may be screened to halftone positives by any standard method as long as the contrast imbalance is preserved in the positives. Make the cyan halftone positive first in order to establish the tone scale of the reproduction. Adjust the exposure to obtain the desired dot size in the picture highlight. The term "picture highlight" refers to a bright, nonspecular neutral area containing some important detail which should be retained in the final reproduction. To reproduce this detail, the highlight dot size in the cyan halftone positive should be just slightly larger than the smallest dot you can hold with your printing conditions. (In lithography these areas should print essentially open with a few scattered fine dots.) Adjust the halftone contrast for the dot you want in the darkest shadows. When you have a satisfactory cyan positive, determine the percent dot area in its A, M, and B patches. (See "Density Measurement of Halftones," page 19.)

Expose the magenta and yellow halftone positives to get a highlight dot in the A patch slightly smaller than that in the cyan. (In no case should the size of the yellow and magenta dots in neutral areas exceed that of the cyan dot.) The magenta and yellow halftones should also have somewhat lower contrast than the cyan halftone. The M and B patches in the halftones serve as convenient control areas to establish these differences.





The M patch of the magenta and yellow positives should be about 15 lower in percent dot area than the corresponding cyan M patch. For example, if your cyan M patch has a 65 percent dot, the M patches of the magenta and yellow should have about a 50 percent dot. In the same way, the B patches should be about 10 lower in percent dot area than the cyan B patch. If you have a 90 percent dot in the cyan B patch, the magenta and yellow B patches should read about 80 percent.

The black-printer positive will vary to meet individual printing needs. An average "skeleton" black should have approximately a 5 to 10 percent dot in the M patch and about a 60 percent dot in the B patch.

The relative percent dot areas of the three halftone positives discussed above are provided as suggestions based on the use of average process inks and normal printing conditions. These relationships should result in a gray scale being reproduced as a visual neutral. If it is not rendered as a neutral, adjustments in dot size and/or in your printing conditions may be necessary to obtain proper gray balance.

HALFTONE SCREEN ANGLES

In all screened color reproduction work, there is the possibility of a noticeable pattern, or "moire," effect in the printed reproduction. The most common causes of this pattern effect are improper trapping of the inks and improper screening. The latter possibility occurs whenever two halftone screen patterns are superimposed in printing. To minimize the moire effect, the screen must be rotated or "angled" to a different position for each color separation screened. The angle between the vertical and one of the parallel lines or rows of dots of a screen is called the "screen angle." Certain combinations of screen angles can be selected to minimize the moire effect.

Sets of pre-angled contact screens are available for the KODAK Magenta Contact Screen (Positive). These screens are manufactured with their rulings accurately positioned at 45, 75, 90, and 105 degrees. Every screen is supplied with a clearly designated reference edge. This edge is shown by large lettering and an arrow at the edge. The ruling and the angle are also marked. This reference edge must be accurately positioned against a fixed edge on the camera back, printing frame, or wherever the screens are used. If a register punch is used, the reference edge must be held firmly against the guide-edge of the punch.

Contact-Printing Lamp

The basic item in a contact-printing area is the contact light source. A contact lamp for photomechanical use must be able to provide uniform illumination over the exposure area. The source itself must be small enough in size and should be located far enough from the exposure plane to approximate a "point" light source. The lamp must have provision for filters to be introduced into the light beam.

The KODAK Adjustable Safelight Lamp, when modified as described in Kodak Publication No. Q-80, **Contact-Printing Lamp for Photomechanical Work,** fulfills these requirements for a contact-light source. Other contact-printing lamps, many with convenience features such as automatic filter changing, are available from graphic arts suppliers. With all lamps it is important to provide some way to reduce or control line voltage variations.

CONTROL OF LINE VOLTAGE VARIATIONS

Changes in the voltage supplied to a contact exposing lamp can cause significant changes in the actual exposure obtained. A change of 1.6 volts can cause an effective speed change of 0.3 Log E. This means that exposure can change by a factor of 2, twice as much or ½ as much, with little more than a 1½-volt change in the voltage delivered to the lamp. If a tap rated at 20 volts on a particular transformer produced only 18.5 volts actual, for example, then a recommended exposure time of 40 seconds would need to be increased to 80 seconds to get the desired exposure. In this case, however, the change in exposure time would be a consistent factor. All exposures would need to be twice as long as the recommended time.

The more serious problem comes from variations in the line voltage supplied to the transformer. Drops in the line voltage are particularly likely to occur in printing plants where large press motors, exposing lamps, and other heavy equipment impose momentary heavy starting loads on the line voltage. Line voltage variations are particularly troublesome because they are unpredictable in degree. If a transformer delivers less than its rated voltage, the exposure time can be increased to compensate. With line voltage fluctuations, no compensating time adjustment can be made. For this reason, all contact-light sources should include a constant-voltage transformer to reduce or minimize variations in the voltage delivered to the light source.

For critical work, such as transparency masking, a means to adjust the voltage may be helpful. In addition to the constant-voltage regulator, a voltmeter and rheostat may be added in the line. This provides the opportunity to read the voltage, and adjust it if necessary, just before making the exposure.

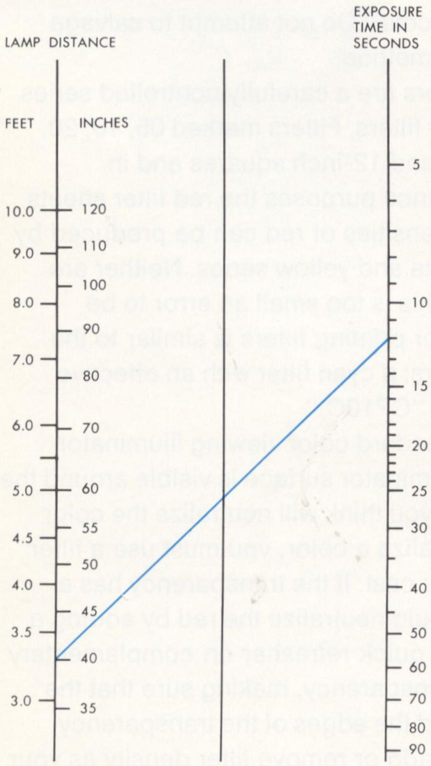
Another factor which can affect exposure intensity in contact-lig sources is the variation possible in the bulbs used. Even new bulbs may vary in intensity, and when a used bulb is replaced, the intensity level is almost certain to increase. For careful control of exposures, replacement bulbs may be checked against an existing standard—either a standard bulb or a recorded photometer reading.

ADJUSTING EXPOSURE TIME TO LAMP DISTANCE

The recommended distance from the exposing lamp to the exposure plane is 40 inches. However, other distances can be used if necessary, because of space limitations, for convenience in handling, or for more convenient exposure times with the standard lamphouse.

The nomograph on this page can be used for establishing the requirements of any contact-printing situation—for masks, separation negatives, and halftones.

Example: From past experience, you have found that a satisfactory mask can be made with an exposure time of 12 seconds when the exposing lamp is 40 inches from the sensitive material. Now it is necessary to make an exposure with the lamp at 65 inches. What is the correct exposure?



1. Place a straightedge on the nomograph so that it crosses the lamp-distance scale at 40 and the exposure-time scale at 12.

2. On the center line between the two scales, put a pencil mark at the point where the straightedge crosses.

3. Using the pencil mark as a pivot, rotate the straightedge until it crosses the distance scale at 65, the desired new distance.

4. With the straightedge aligned with the desired distance and the pivot point on the center line, read the new exposure time at the point where the straightedge crosses the exposure-time scale: about 32 seconds.

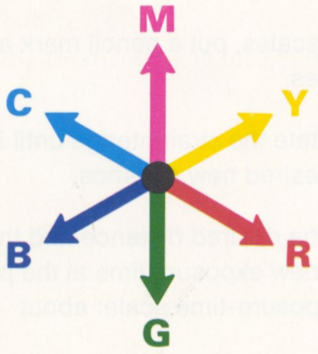
Correcting Transparencies for Reproduction

The directions for making masks and separation negatives given thus far in this data book assume that the transparent originals are of satisfactory quality—correctly exposed and with proper color balance—for use in photomechanical color reproduction. This, of course, is not always true—often transparencies which are less than ideal must be used as original copy. Handwork on the films or plates can sometimes improve the reproduction from poor originals, but such handwork is time consuming and costly. This section suggests some techniques which can be useful for "correcting" transparencies before the color-separation process is applied.

ADJUSTING COLOR BALANCE IN TRANSPARENCIES

In some cases, a transparency provided as original copy may have faulty color balance, or a customer may wish to shift the color balance to suit his requirements. The transparency may, for example, have an overall bluish cast, or a customer may choose to introduce a reddish tone to create a special mood in the reproduction. With KODAK Color Printing Filters (Acetate) used as overlays, the transparency can be adjusted both for customer viewing and for subsequent masking and separation. Such adjustments should only be made for slight imbalances in color. Do not attempt to salvage a really bad transparency by this method.

The KODAK Color Printing Filters are a carefully controlled series of cyan, magenta, red, and yellow filters. Filters marked 05, 10, 20, and 40 are provided in 5-, 6-, 8-, and 12-inch squares and in 8 x 10-inch sheets. For color-balance purposes the red filter sheets are not needed, since all these densities of red can be produced by equal combinations of the magenta and yellow series. Neither are the 0.05 densities necessary, as this is too small an error to be obvious. The coding of these color printing filters is similar to the listing of color compensating filters; a cyan filter with an effective density of 0.10 would be listed as "CP10C."



Cyan, magenta, and yellow, the primary printing colors, have complementary colors of red, green, and blue, respectively.

Place the transparency on a standard color viewing illuminator (5000 K), making sure that the illuminator surface is visible around the transparency. Select the CP filter you think will neutralize the color imbalance or color cast. To neutralize a color, you must use a filter of the **complementary** color to the cast. If the transparency has a reddish cast, for example, you would neutralize the red by adding a cyan filter. Use the diagram for a quick refresher on complementary colors. Place the filter over the transparency, making sure that the filter sheet does not extend beyond the edges of the transparency.

After viewing the combination, add or remove filter density as your judgment indicates. A combination of color filters may also be used. When you are satisfied with the correction, you are ready to carry the transparency into the masking and separation steps. (This is also a good opportunity to show the customer your improvement of his transparency.)

Attach clean CP filter sheets of the value you have selected to the outside of the printing frame glass or to the transparency jig on the side facing the light source. Cover **only** the transparency, **not** the A, M, and B control patches. Add KODAK WRATTEN Neutral Density Filter, No. 96, over the A, M, and B patches to compensate for the density of the CP filters used. The density over the patches should be **one-half** the total density of the CP filter(s) used. For example, if the transparency is covered with a CP20M and a CP10Y filter (total filter density of 0.30) then cover the A, M, and B patches with 0.15 in neural density. Increase exposures slightly to compensate for this added density and make masks and separations as before.

NOTE: CP filter designations are derived from densitometer readings made through filters whose colors are complementary to the colors of the CP filters. For example, CP magenta filters have their densities read through a green filter. A CP10M filter, therefore, will not have the same visual "white-light" density as a neutral density sheet of .10 density.

EQUALIZING—COMPENSATING FOR DARK OR LIGHT TRANSPASENCIES

When the original transparency is excessively dense or excessively light compared with a normal transparency, the relationship of the A-patch density to the highlight density must be adjusted. This process applied to the masked highlight and A-patch density is called equalizing. The purpose of equalizing is to maintain the density of the masked A patch at 0.05 to 0.10 **higher** than the masked highlight of the transparency. Equalizing applies only to transparencies that are dark or light due to underexposure or overexposure. Do not apply it to correctly exposed transparencies that are intended to be dark or light in tone.

Make the masks as before. Temporarily register the mask for the cyan printer with the transparency, and measure the densities of the **masked** highlight of the transparency and the **masked** A patch. If the masked highlight density of the transparency exceeds that of the masked A patch, add KODAK WRATTEN Neutral Density Filter, No. 96, to the three patches of the Transparency Guide. Then added density should be sufficient to raise the masked density of the A patch to 0.05 to 0.10 over that of the masked transparency highlight. The same amount of density **must** be added to the M and B patches also. Make separation negatives in the normal way, but with a slight increase in exposure to compensate for the added density.

Transparencies that are excessively light may be increased in density to within 0.10 to 0.05 below the masked density of the A patch. Follow the same procedure as above **except** add neutral density sheeting over the picture area, not over the A, M, and B patches.

The neutral density sheeting needed for this use may be prepared by developing unexposed KODALITH Ortho Film 3556, Type 3 (ESTAR Thin Base) in KODAK DEKTOL Developer (1:1). Since the fogging effect of this developer on KODALITH Film may vary, it is not practical to aim for a specific density. A series of development times of 30 seconds, 45 seconds, 1 minute, 2 minutes, and 3 minutes gives a useful range of densities. If lower densities are needed, use the developer at a 1:3 dilution rather than cut developing time below 30 seconds. To get the most even results, develop individually, stop with vigorous agitation in an acetic acid stop bath, and fix in freshly mixed KODAK Rapid Fixer.

NOTE: Density sheeting produced this way should **not** be used over a lens in place of regular neutral density filters. Used in a lens system, these sheets can cause loss of image quality. They are satisfactory for use over a transparency on the outside of a printing-frame glass or taped to the back of a mask.

The positioning of the neutral density sheeting must not interfere with good contact between the unexposed separation negative film, the transparencies, and the mask. If you use a single dye-image mask such as one made with KODAK Tri-Mask Film 4104, you can attach the neutral density sheeting directly to the mask on the side facing the light source. If you are using several silver masks, the positioning of the neutral density sheeting is a matter of convenience. You can strip the sheeting to a separate jig, or, if you are contact-printing with a glass-topped vacuum frame or printing frame, you can attach the sheeting directly to the outside of the glass.

NORMALIZING GANGED TRANSPARENCIES

Frequently two or more transparencies are combined (ganged) to be masked and separated as a unit. (They may also be screened as a unit, or screened separately if different size changes are needed.) Since these transparencies are to be carried through the reproduction process as a single unit, they must all be similar in highlight density and color balance. If the volume of transparencies handled is sufficiently high, those that most closely match in density and color balance may be selected and ganged. Others that do not match a particular group, can be matched into other ganged units. Obviously, this ideal condition is seldom met and transparencies that do not match in density must be ganged. In this situation all the highlight densities must be made to match. By adding neutral density sheeting to all the lighter density transparencies of a group until they match the highlight density of the darkest transparency of the group, you effectively **normalize** all the originals into a single unit.

The easiest way to **approximately** normalize a group of ganged transparencies is by visual inspection. Arrange the transparencies on a standard color illuminator (5000 K) leaving some space between for reference. Select the lightest transparency and try different neutral density sheets over it until it visually matches the darkest transparency. Repeat the process with what is now the lightest transparency, and continue until all have been visually matched to the darkest transparency. Then the selected densities are set aside until after the masks are made from the ganged transparencies. When the masks are registered with the transparencies, the neutral density sheets are positioned over the appropriate transparency before the separation negatives are made. Although this method relies on the subjective judgment of the viewer, it is a reasonable approximation and may be the only method to use when the highlights of a transparency are too small to be read with a transmission densitometer.

The most accurate method of normalizing ganged transparencies is to measure the highlight densities with a transmission densitometer. Make the masks and temporarily register the mask for the cyan printer with the ganged transparencies. Carefully read and record the highlight density of each of the masked transparencies. The highest density reading will be the control density to which the other transparencies are normalized.

NOTE: In normalizing ganged transparencies, it is assumed that all transparencies that do not have proper color balance will already have been adjusted for color balance as discussed on page 26.

For each transparency, subtract its masked highlight density from the control density to determine the amount of neutral density that must be added to that transparency for normalizing. (See example.) Add that amount of neutral density sheeting to each transparency before making the separation negatives.

Actual Masked Highlight Density	Density Required For Normalizing	Neutral Density Sheeting Required
1.48	1.66	.18
1.66 Control Density	1.66	—
1.53	1.66	.13
1.61	1.66	.05

After the ganged transparencies are normalized, the common highlight density must be equalized to the A patch as described on page 27. After equalization, proceed to make the separation negatives as though handling a single transparency.

IMAGE ORIENTATION

The image orientation of transparencies differs depending on the film material used and the way they were made. For example, a transparency made on KODAK EKTACHROME Film is right-reading when viewed through the base while being placed in the KODAK Register Printing Frame with the emulsion side down. On the other hand, a transparency made on KODAK EKTACOLOR Print Film 4109 (ESTAR Thick Base) is usually wrong-reading when viewed through the base. Duplicates of original transparencies may have either orientation, depending on how they were made.

When separating a single transparency, therefore, we suggest always placing the transparency emulsion side down in the printing frame when making the masks, regardless of the image orientation. Later when you make the separation negatives from the masked transparency, the transparency and the negative film will then be in emulsion-to-emulsion contact. This assures the best possible sharpness in the negatives. If this results in the wrong image orientation, the proper orientation can be achieved when you make the halftone positives on the process camera, contact-print halftone negatives, or duplicate the original halftone positives.

The problem of image orientation becomes more significant if you are separating ganged transparencies. When you are ganging only for convenience and plan to get final size while making the halftone positives, there is no problem. You can work with all the transparencies, emulsion down, then cut the ganged negatives apart, and get proper image orientation in the halftone stage as before. However, if you are ganging sized transparencies in a final layout, and expect to keep the negatives ganged for screening, you must deal with the problem of image orientation when preparing the transparencies prior to mask making.

It would be preferable to have the same orientation in all the transparencies and to place them all in the printing frame, emulsion down. Usually, however, the transparencies will be on various types of film with different orientations. When the transparencies are in proper image orientation, some will be emulsion side up; some, emulsion side down. Consequently, you must expect that some will be less sharp in the final reproduction than others, since some will be out of contact when the separation negative film is exposed.

Perhaps the copy or the job is such that you can accept this slight reduction in sharpness. If not, sharpness may be improved by removing the diffusion sheet from the lamp housing while you make the negatives. If you remove the sheet, check your lamp bulb carefully. The diffusion sheet was placed in the lamp to reduce uneven illumination resulting from striations in the glass of the lamp bulb, and to help minimize the effect of dust particles on the printing-frame glass.

Viewing Conditions for Originals and Reproductions

Throughout the process of photomechanical color reproduction, the original and the reproduction are viewed and judged for color quality. Pre-press proofs may be used for decisions on color correction; first press proofs are compared with the originals; corrected proofs are checked; proofs or press sheets are submitted to the client; approved press sheets are used to check production runs. In all these applications, the use of a standard viewing condition is essential to avoid misunderstanding and confusion in suggested changes or corrections.

There are two basic viewing situations to consider: the comparison of the original—transparency or reflection copy—with a reproduction, and the comparison of a printed proof or approved press sheet with the production press sheets. In the terminology of the American National Standards Institute's standard on viewing conditions, the first case—original and reproduction—is referred to as "Appraisal of Color Quality." The ANSI standard terms the second case—comparison of proof to production run—"Appraisal of Color Uniformity." There are differences in the standard conditions for these two types of viewing situations.

VIEWING CONDITIONS FOR THE APPRAISAL OF COLOR QUALITY

This viewing situation is complicated by the need to provide for viewing both transparent originals and reflection originals (flat copy) with their reproductions. Both the back illumination for the transparency and the general room illumination for the "flat" work or reflection copy must be specified. Since the physical area surrounding the viewing surface can affect the illumination, this area must be specified also.

The ANSI standard "Viewing Conditions for the Appraisal of Color Quality and Color Uniformity in the Graphic Arts"* specifies viewing conditions in great detail and exactness. It includes the color temperature and spectral distribution of the illumination; the General Color Rendering Index; the geometry of both the transparency illuminator and the print illuminator; the surface luminance of the transparency illuminator; the level of print illumination; and the environmental conditions around the viewing surface. Many of these factors are considerations for the supplier of the light sources and viewing booths. The conditions of most general interest are:

1. The color temperature of both the transparency illuminator and the print illuminator is 5000 Kelvin.

2. The transparency must have an illuminated border at least 2 inches wide on at least three sides of the transparency.

3. The positioning of the reflection original or reproduction and the illuminant must be such as to minimize specular reflections.

4. The physical surfaces of the viewing room or booth must be neutral in color and make no color contribution to the viewing situation.

VIEWING CONDITIONS FOR THE APPRAISAL OF COLOR UNIFORMITY

This part of the ANSI standard details the color temperature, spectral distribution, and level of the illumination; the General Color Rendering Index; and the environmental conditions. The major difference from the color-quality appraisal standard is the absence of transparency viewing specifications and the use of 7500 Kelvin as the standard color temperature. This viewing situation is intended for comparison of approved press sheets against production press sheets rather than for any comparison with the original.

---

*ANSI PH2.32-1972 available from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

Additional Notes

TRANSPARENCY MASKING ON THE PROCESS CAMERA OR ENLARGER

Size change is usually accomplished when screen positives are made on the process camera. For an enlargement greater than can be made in one step, it is necessary to make enlarged separations.

When an enlarger or a camera is to be used, the masks may be made by projection to the full size of the desired negative. The separation negatives are then made with the mask registered with the projected image of the transparency. The KODAK WRATTEN Filters used should be photomechanical (PM) filters.

Another method is to register the mask with the transparency and project the masked image. Either silver masks or KODAK Tri-Mask Film 4104 may be used on a process camera or on a diffuse enlarger. When a condenser enlarger is used, the Q-Factor* of the silver masks must be taken into account. Silver images scatter the light from a specular light source. This scattering effectively increases the contrast of the mask. A silver mask for projection by specular light sources must be made to lower contrast to compensate for this effect. While the exact requirements for the mask may vary between different condenser enlargers, an A-B range of 0.80 and a Mask Number of 0.15 may be used as a starting point. With a dye-image mask, such as a mask on KODAK Tri-Mask Film 4104, no contrast adjustment is necessary.

With either technique, use KODAK Separation Negative Film 4131, Type 1, and the filters and aim points recommended in this pamphlet.

When making extreme enlargements, for example, enlarging 35 mm originals to page-size reproductions, problems of grain structure and apparent unsharpness may occur in the reproduction. In this situation the finer grain structure of KODAK Separation Negative Film 4133, Type 2, may be of advantage and this film may be used in place of the KODAK Separation Negative Film 4131, Type 1, which is normally recommended for color separation from masked transparencies. The filters recommended for use with Separation Negative Film, Type 2, in camera-back masking† should also be used. Table 8 gives the basic machine-processing conditions for this use of KODAK Separation Negative Film 4133, Type 2. Further information —particularly in regard to establishing average replenishment rates and for fine-tuning the average machine speeds in the table— is contained in the Machine Processing Data Release for this film. These Data Release Sheets are available from Eastman Kodak Company, Department 662-C, Rochester, N.Y. 14650. Please specify film, processor, and chemicals.

---

*The Callier Coefficient, or Callier Q-Factor, of a film is the ratio of its specular density to its diffuse density:

$$\text{Q-Factor} = \frac{\text{Specular Density}}{\text{Diffuse Density}}$$

For further information, see **The Theory of the Photographic Process,** by C. E. Kenneth Mees and T. H. James, The Macmillan Company, New York, 3rd Edition, 1966.

†Kodak Publication No. Q-7B, **Camera-Back Silver Masking with three-aim-point control,** available from graphic arts dealers.

Table 8

SUGGESTED MACHINE-PROCESSING CONDITIONS KODAK Separation Negative Film 4133, Type 2

Processor	KODAK VERSAMAT Film Processor, Model 317
Processing Solutions	KODAK VERSATONE 868 Developer Starter KODAK VERSATONE 868 Developer Replenisher KODAK Rapid Fixer
Processing Temperatures	Developer .... 80 F ± ½ F Wash .... 70 to 75 F Dry .... 100 F
Machine Speed	
Cyan Printer	26 in. per min
Magenta Printer	23 in. per min
Yellow Printer	23 in. per min
Black Printer	25 in. per min
Process Control	KODAK Continuous-Tone Process Control Strips. (Instructions are packaged with the strips.)
Basic Replenishment Rates	Developer—0.25 ml per square in. Fixer—0.50 ml per square in.

MASK NUMBER

Recommended aim points for masking—Mask Number and A-B range—are given on page 9. These are general aim points, a starting point designed for the "average" condition. Changes in these aim points, particularly in Mask Number, can tailor these aim points to suit individual conditions or specific types of original copy. This section will attempt to illustrate the effect on the reproduction of changes in Mask Number.

A major function of the mask is to reduce the contrast of the original so that we can better handle that original within the density range limitations of the reproduction process. By combining the mask with the original, we reduce contrast and density range as measured by the A-B range. If we use the A, M, and B patches of the KODAK Three-Point Transparency Guide to represent the highlights, middletones and shadows, respectively, of the original, and use the example of A, M, and B patch densities of the mask as given on page 9, we can show the contrast-reducing result of combining the mask and the original.

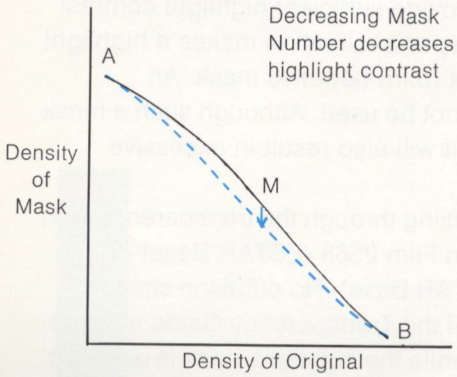
	Density		
	A-Patch	**M-Patch**	**B-Patch**
Original	0.40	1.30	2.40
Mask	1.15	0.80	0.25
Combination	1.55	2.10	2.65

NOTE: Definite density values for the Three-Point Transparency Guide are indicated here for use in this example. Actual guides may not have exactly these density values. The guides are controlled to maintain the density difference between the patches rather than the patch density.

Adding the densities of the original and the mask, we get a representation of the densities of the combination of the original and the mask. The total density range, the A-B range, of the original is 2.00 (2.40 minus 0.40). The A-B range of the combination is 1.10 (2.65 minus 1.55). The mask has reduced the overall density range of the original by 0.90.

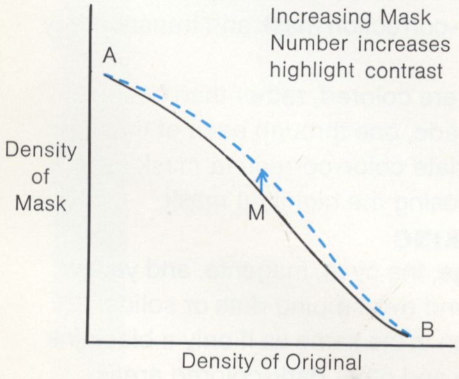
The primary control of tone reproduction is the curve shape of the separation negative as defined by the recommended A-M and M-B ranges of the negative. However, since the curve shape of the mask also affects the separation negative, the mask also has an important function in tone reproduction. As we reduce the contrast of the original with the mask, we must do it in such a way as to achieve the tone reproduction we desire.

Mask Number is the control and measure of the curve shape of the mask. The recommended Mask Number and the separation negative aim points result in the tone reproduction recommended for average conditions and copy. This is a reproduction where the necessary contrast reduction occurs more in the shadow area of the reproduction than in the highlight area. More contrast is maintained in the highlight to middletone area to maintain adequate tone separation and detail in this critical area.



For certain types of originals or for specific conditions, the Mask Number may be decreased or increased within reason. The diagram at the upper left shows a typical mask curve (solid line) and how it might change with a lower Mask Number when A-B range is constant (dotted line).

Decreasing the Mask Number lowers the M patch density in the mask relative to the A and B patch densities. This change in the curve shape of the mask **decreases** the A-M range in the separation negative while **increasing** the M-B range. The result is increased contrast and improved detail in the middletone to shadow area of the reproduction than is obtained with recommended Mask Number. Of course, contrast and detail are reduced in the highlight to middletone area. With a low-key original where the important detail is in the middletone to shadow area, and the highlights are less important, decrease Mask Number to improve shadow detail.



The diagram at the lower left shows a typical mask curve (solid line) and how it might change with a higher Mask Number when the A-B range is kept constant (dotted line). Increasing the Mask Number raises the M patch relative to the A and B patches of the mask. The altered curve shape of the mask **increases** the A-M range in the separation negatives and **decreases** the M-B range. The result is increased contrast and improved detail in the highlight-to-middletone area of the reproduction compared with the recommended Mask Number. This improved highlight contrast and detail is suited to a high-key original, where all detail is in the highlight to middletone range and the shadows are unimportant.

The color-correcting function of the mask is mainly a factor of the mask filter used and the A-B range of the mask. Moderate changes in Mask Number for tone reproduction purposes are not likely to affect color reproduction. Extreme changes in Mask Number, however, may affect color reproduction. This is particularly true with a high Mask Number which will reduce the already rather low degree of color correction in the highlights while overcorrecting the shadows. Low Mask Numbers tend to increase color correction in the highlights and undercorrect the shadows.

HIGHLIGHT MASKS

The use of a highlight pre-mask is not recommended as standard procedure in the reproduction of transparencies. Correctly made masks and separation negatives provide sufficient highlight contrast with most transparencies. If some special situation makes a highlight mask necessary, use a rather weak (thin) negative mask. An unnecessarily strong mask should not be used. Although such a mask will exaggerate highlight contrast, it will also result in excessive density in the middletones.

Make the highlight mask by exposing through the transparency with unfiltered light onto KODALITH Pan Film 2568 (ESTAR Base) or KODALITH MP Pan Film 2558 (ESTAR Base). No diffusion sheeting is used. The A, M, and B patches of the Transparency Guide must be covered with black paper or tape while the highlight mask is exposed. Develop the mask in KODAK Developer DK-50 (1:2). Disregarding catchlights, the maximum density in the picture area of the highlight mask should be between 0.25 and 0.50. Density **range** should be between 0.15 and 0.40.

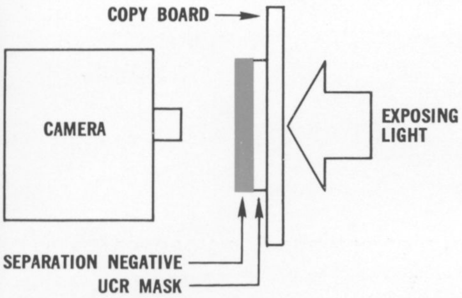
Uncover the Transparency Guide, register the highlight mask to the transparency, and make the color-correcting masks from this combination. Remove the highlight mask and make separation negatives from the combined color-correction mask and transparency in the usual way.

When the highlights in the copy are colored, rather than neutral, three highlight masks should be made, one through each of the separation filters. Use the appropriate color-correcting mask over the KODALITH Pan Film while exposing the highlight mask.

UNDERCOLOR REMOVAL MASKING

In neutral areas of the printed image, the cyan, magenta, and yellow plates all deposit ink as adjacent and overlapping dots or solids. The visual result of this combination is the same as if only a black ink were printed in these neutral areas and other dark-colored areas where all three inks normally print. In effect, the use of an undercolor removal (UCR) mask reduces the amounts of the three colors and allows the black plate to carry more of the image. This reduces ink-trapping problems, makes press control less critical, and allows the substitution of black ink for expensive colored inks.

If a UCR mask is to be used, the original preparation of the copy should include a step tablet along with the transparency and the KODAK Three-Point Transparency Guide. Make the color-separation negatives as before. The black negative, however, should have



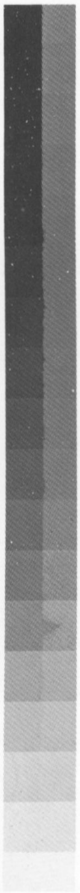
special characteristics. Instead of the usual overexposure, the M-B range of the black negative should be the same as that of the cyan separation negative. Make the UCR mask on KODAK Blue Sensitive Masking Film 2136 (ESTAR Base) by exposing the film with the emulsion in contact with the base of the black separation negative. Use a piece of KODAK Diffusion Sheet between the negative and the masking film to provide mask unsharpness. Before exposing the mask, cover half the width of the step tablet and half of the A, M, and B patches on the black negative with opaque black tape. (Remember to remove this tape before making the black halftone positive.)

The exposure of the UCR mask controls the amount of undercolor removal obtained. The more the mask is exposed, the greater the amount of undercolor removal and the further it will extend into the highlight areas. As the amount of undercolor removal is increased, proper color correction in the original black separation negative becomes more important. To avoid removing too much color in areas not properly recorded in the black separation negative, reduce the exposure of the UCR mask.

Develop the mask to a contrast that permits cancellation in the shadow end of the separation negatives, for about 3½ minutes in KODAK Developer DK-50 (full-strength). For most purposes, the B-patch density of the mask should be between 0.30 and 0.60, depending on the amount of undercolor removal desired. For a total dot area of 240 percent (as specified for high-speed, wet letterpress printing) the B-patch density should be about 0.75.

Use the UCR mask in making the halftone positives. Register the mask, in turn, with each of the three color-corrected separation negatives. The mask will add an equal density to the three negatives wherever black is to be printed.

When exposing the halftone positives, keep the separation negative toward the camera lens, with the UCR mask between the negative and the light source. Both the covered and the uncovered halves of the A, M, and B patches and the step tablet are used for control in screening. The covered areas have received no undercolor removal, and this portion of the A, M, and B patches can be used as described in the section on making halftone positives, page 16. The uncovered halves of the patches provide a means of evaluating the amount of undercolor removal in the halftone positives. Compare the two halves of the step tablet to see the effect of undercolor removal throughout the tone scale. It is strongly suggested that the first attempt at undercolor removal masking be made from an original which has already been satisfactorily reproduced without UCR masking. In this way, a visual comparison of the halftones can be made to provide a further guide to screening.


The right side of the step tablet shows the effect of moderately full undercolor removal on the tone scale of the cyan halftone positive.

The tone scales should appear similar in the continuous-tone UCR mask and in the black halftone positive, except that the positive should have somewhat more contrast. (The UCR mask is not used in making the black halftone positive from the black separation negative. To avoid register problems, a sheet of fixed-out film of the same thickness should be used in place of the UCR mask.)

D1C-18 Dyetrans

$80

Graphics Markets Division

EASTMAN KODAK COMPANY · ROCHESTER, N.Y. 14650

Silver Masking of Transparencies
with three-aim-point control
Kodak Publication No. **Q-7A**

Major Revision
140-5-74-BE
Printed in the United States of America

Kodak, Estar, DK-50, HC-110, Wratten, Kodalith, Dektol, Photo-Flo, Versatone, Versamat, Ektachrome, and Ektacolor are trademarks.

CAT 105 4741